Quantifying Efficacy of Submersed Aquatic Vegetation Management in the Sacramento-San Joaquin Delta

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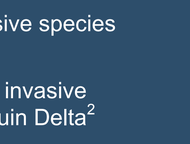
BACKGROUND

- Invasive Submersed Aquatic Vegetation (SAV)
  - clogs waterways and restricts navigation
  - eco-engineers environment[1]
    - ⇒ displaces native species
    - ⇒ Reduces water flow and turbidity
    - ⇒ creates habitat that supports other invasive species
- Division of Boating and Waterways (DBW)
  - designated state lead agency in controlling invasive aquatic plants in the Sacramento-San Joaquin Delta[2]
- Control Method: Fluridone (herbicide)
- Methods of monitoring and mapping SAV
  - hydroacoustic surveys
  - field surveys (visual and rake sampling)
- DBW hydroacoustic system
  - Lowrance™ consumer-grade echosounders[3]
  - Biobase[4]
    - ⇒ generates data on water depth, SAV presence/absence, SAV height, bottom hardness (composition), and biovolume.
    - ⇒ cost effective, user-friendly and faster data processing time compared with other hydroacoustic systems[5]

METHODS

- Herbicide Treatment and Survey Areas
  - 26 DBW sites (Fig. 1)
  - Surveyed for pre and post-treatment
    - ⇒ February 2016 - November 2016
- Equipment
  - Lowrance™ HighDefinition System®
    - ⇒ Single beam 20° down-scan transducer
    - ⇒ GPS WAAS- corrected (± 3m)
- Sonar Transect Design
  - 10 - 30 m
    - ⇒ Dependent on site shape and size
- Data Analysis
  - Upload sonar files (.sl2 and .slg) to Biobase
  - Download processed data (.csv files)
    - ⇒ GPS coordinates
    - ⇒ Biovolume : proportion of plant height to water depth
  - Import to ArcGIS customized “Egeria” tool
  - Outputs (Figs. 2, 3, 4, and 5)
    - ⇒ Percent biovolume rasters and change detection
    - ⇒ Percent cover derived from biovolume data and calculated as (total SAV cover / total area of site)
  - Metrics
    - ⇒ Mean percent biovolume change (all sites, t-test)
    - ⇒ Mean percent cover change (all sites, t-test)
  - Geotagged photos were taken in areas where SAV was observed at water surface (~100% biovolume) during Franks Tract survey for assessment of sonar accuracy



PURPOSE

- Apply consumer-grade hydroacoustics to map submersed aquatic vegetation in the Sacramento-San Joaquin Delta
- Process sonar files using online GIS algorithm
- Generate SAV geo-spatial products and change detection
- Conduct accuracy assessment
- Provide quantitative metrics for SAV management purposes

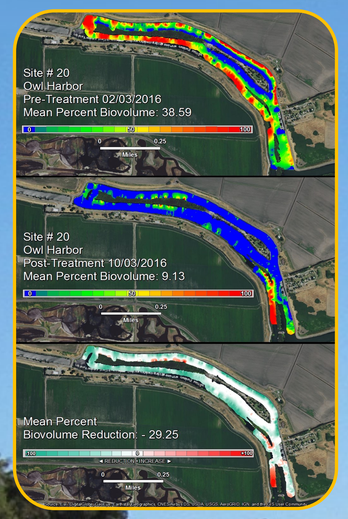


Figure 2. Pre and post-treatment biovolume maps and change detection for Owl Harbor. The biovolume color scale ranges from 0% (blue) to 100% (red) at 5% increments. The change detection color scale ranges from 100% reduction (teal) to no change (white) to 100% increase (red) at 10% increments.

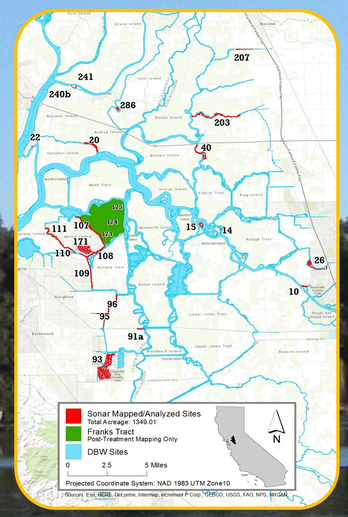


Figure 1. SAV treatment site reference map

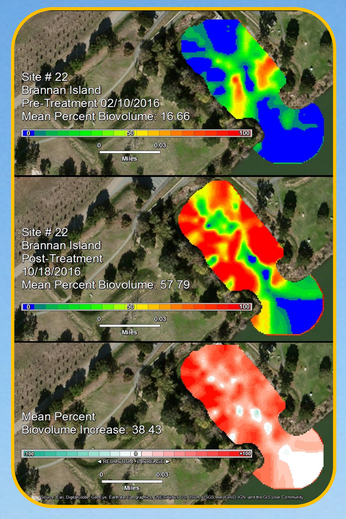


Figure 3. Brannan Island (Site 22) had the highest increase in biovolume possibly due to proximity to the main river channel. This 2017 season we plan to incorporate hydrologic flow models in our data analysis to improve treatment efficacy.

RESULTS

- 23 of the 26 SAV treatment sites were surveyed for pre- and post-treatment for a total of 1349 acres (mapped and analyzed)
- Individual site results for percent change in biovolume and SAV percent cover shown in Figures 6 and 7, respectively
- The overall mean reduction in biovolume for all 23 sites was 7.87% ± 6.3 (t = -2.1539, p = 0.02181)
- The overall mean reduction in SAV cover was -9.10% ± 7.69 (t = -2.0402, p = 0.02738)
- Qualitative accuracy assessment conducted in Franks Tract revealed 24 photographs of SAV visible at water surface corresponded with areas of high biovolume (Fig. 5)

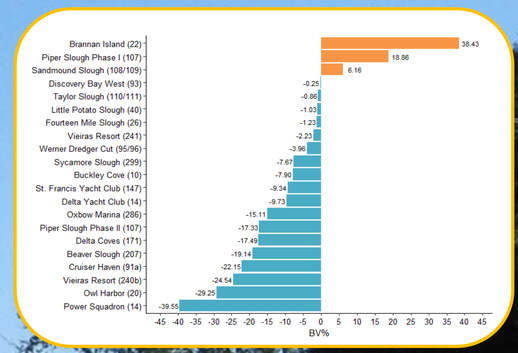


Figure 6. Results graph for percent change in biovolume at treatment sites. Site numbers are in parenthesis adjacent to site names.

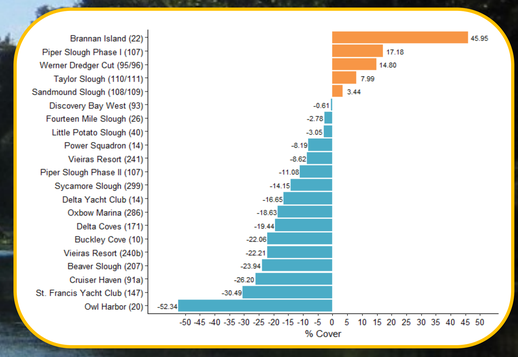


Figure 7. Results graph for change in percent cover. Site numbers are in parenthesis adjacent to site names.

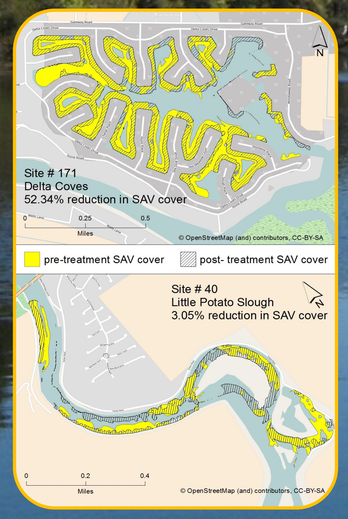


Figure 4. Percent cover maps for Delta Coves and Little Potato Slough. Percent cover maps enable us to visualize the extent of reduction or increase in SAV and calculate total area of infestation.

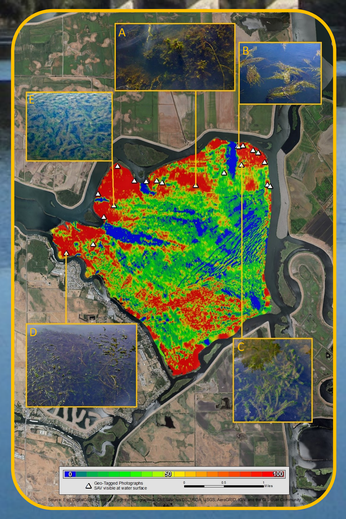


Figure 5. Geotagged photographs of “topped-out” SAV corresponding with areas of high biovolume (red) in the raster image. SAV species in this figure include: **A.** coontail (*Ceratophyllum demersum*), **B.** sago pondweed (*Stuckenia pectinate*), **C**,**D**, and **E**. Brazilian waterweed (*Egeria densa*).

DISCUSSION

- These quantitative metrics set a baseline for future comparisons
- First treatment season that hydroacoustic surveys and analysis were incorporated in a more robust and systematic fashion
- Future research needs
  - Acquisition of a Delta hydrological flow model
  - Comparison with Delta-area hyperspectral imagery[6]
  - SAV point-intercept surveys and diversity study
  - Identification of variables affecting treatment efficacy

LITERATURE CITED

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For more information about the 2016 Submersed Aquatic Vegetation Control Program visit the Aquatic Invasive Species page of the DBW website at http://dbw.parks.ca.gov/ or contact me at Micheal.Finnell@parks.ca.gov